be leak free at not less than 225 psig using dry air or inert gas before installation and thereafter every 2 years when performing the required periodic retest in §180.407(c) of this subchapter. Prior to each loading, the cargo tank motor vehicle must be inspected and the angle valves and gasketed joints must be examined and tested at a pressure of not less than 50 psig to determine that they are not leaking and are in proper condition for transportation. Any leaks must be corrected before the cargo tank motor vehicle is offered for transportation.

(3) Excess flow valves on the cargo tank motor vehicle must meet the requirements of paragraph (n) of this section.

(p) *Fusible elements.* Each MC 330, MC 331, or nonspecification cargo tank authorized under paragraph (k) of this section must have a thermal means of closure for each internal self-closing stop valve as specified in §178.337–8(a)(4) of this subchapter.

(q) Manifolding is authorized for cargo tanks containing anhydrous ammonia provided each individual cargo tank is equipped with a pressure relief device or valves and gauging devices as required by paragraphs (h) and (i) of this section. Each valve must be tightly closed while the cargo tank is in transit. Each cargo tank must be filled separately.

[29 FR 18743, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §173.315, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at *www.fdsys.gov*.

§173.316 Cryogenic liquids in cylinders.

(a) *General requirements.* (1) A cylinder may not be loaded with a cryogenic liquid colder than the design service temperature of the packaging.

(2) A cylinder may not be loaded with any material which may combine chemically with any residue in the packaging to produce an unsafe condition.

(3) The jacket covering the insulation on a cylinder used to transport any flammable cryogenic liquid must be made of steel.

(4) A valve or fitting made of aluminum with internal rubbing or abrading aluminum parts that may come in contact with oxygen in the cryogenic liquid form may not be installed on any cylinder used to transport oxygen, cryogenic liquid unless the parts are anodized in accordance with ASTM Standard B 580 (IBR, see §171.7 of this subchapter).

(5) An aluminum valve, pipe or fitting may not be installed on any cylinder used to transport any flammable cryogenic liquid.

(6) Each cylinder must be provided with one or more pressure relief devices, which must be installed and maintained in compliance with the requirements of this subchapter.

(7) Each pressure relief device must be installed and located so that the cooling effect of the contents during venting will not prevent effective operation of the device.

(8) The maximum weight of the contents in a cylinder with a design service temperature colder than −320 °F. may not exceed the design weight marked on the cylinder (see §178.35 of this subchapter).

(b) *Pressure control systems.* Each cylinder containing a cryogenic liquid must have a pressure control system that conforms to §173.301(f) and is designed and installed so that it will prevent the cylinder from becoming liquid full.

(c) *Specification cylinder requirements and filling limits.* Specification DOT-4L cylinders (§178.57 of this subchapter) are authorized for the transportation of cryogenic liquids when carried in the vertical position as follows:

(1) For purposes of this section, ''filling density,'' except for hydrogen, is defined as the percent ratio of the weight of lading in the packaging to the weight of water that the packaging will hold at 60 °F. (1 lb. of water = 27.737 cubic inches at 60 °F.).

(2) The cryogenic liquids of argon, nitrogen, oxygen, helium and neon must be loaded and shipped in accordance with the following table:

Pressure control valve setting (maximum start-to-discharge pressure psig)	Maximum permitted filling density (percent by weight)					
	Air	Argon	Nitrogen	Oxygen	Helium	Neon
45	82.5	133	76	108	12.5	109
75	80.3	130	74	105	12.5	104
105	78.4	127	72	103	12.5	100
170	76.2	122	70	100	12.5	92
230	75.1	119	69	98	12.5	85
295	73.3	115	68	96	12.5	77
360	70.7	113	65	93	12.5	
450	65.9	111	61	91	12.5	
540	62.9	107	58	88	12.5	
625	60.1	104	55	86	12.5	
Design service temperature (°F.)	−320	−320	−320	−320	−452	−411

(3) Hydrogen (minimum 95 percent parahydrogen) must be loaded and shipped as follows:

Column 1	Column 2
Design service temperature	Minus 423 °F. or colder.
Maximum permitted filling density, based on cylinder capacity at minus 423 °F (see Note 1).	6.7 percent.
The pressure control valve must be designed and set to limit the pressure in the cylinder to not more than.	17 psig.

NOTE 1: The filling density for hydrogen, cryogenic liquid is defined as the percent ratio of the weight of lading in a packaging to the weight of water that the packaging will hold at minus 423 °F. The volume of the packaging at minus 423 °F is determined in cubic inches. The volume is converted to pounds of water (1 lb. of water = 27.737 cubic inches).

(i) Each cylinder must be constructed, insulated and maintained so that during transportation the total rate of venting shall not exceed 30 SCF of hydrogen per hour.

(ii) In addition to the marking requirements in §178.35 of this subchapter, the total rate of venting in SCF per hour (SCFH) shall be marked on the top head or valve protection band in letters at least one-half inch high as follows: ''VENT RATE**SCFH'' (with the asterisks replaced by the number representing the total rate of venting, in SCF per hour).

(iii) Carriage by highway is subject to the conditions specified in §177.840(a) of this subchapter.

(d) *Mixtures of cryogenic liquid.* Where charging requirements are not specifically prescribed in paragraph (c) of this section, the cryogenic liquid must be shipped in packagings and under conditions approved by the Associate Administrator.

[Amdt. 173–166, 48 FR 27695, June 16, 1983, as amended by Amdt. 173–166, 49 FR 24314, June 12, 1984; Amdt. 173–180, 49 FR 42735, Oct. 24, 1984; Amdt. 173–201, 52 FR 13041, Apr. 20, 1987: Amdt. 173–250, 61 FR 25942, May 23, 1996; Amdt. 173–261, 62 FR 24741, May 6, 1997; 66 FR 45379, Aug. 28, 2001; 67 FR 16013, Sept. 27, 2002; 68 FR 75742, Dec. 31, 2003; 69 FR 54046, Sept. 7, 2004]

§173.318 Cryogenic liquids in cargo tanks.

(a) *General requirements.* (1) A cargo tank may not be loaded with a cryogenic liquid colder than the design service temperature of the packaging.

(2) A cargo tank may not be loaded with any material that may combine chemically with any residue in the packaging to produce an unsafe condition (see §178.338–15).

(3) The jacket covering the insulation on a tank used to transport a cryogenic liquid must be made of steel if the cryogenic liquid:

(i) Is to be transported by vessel (see §176.76(g) of this subchapter); or

(ii) Is oxygen or a flammable material.

(4) A valve or fitting made of aluminum with internal rubbing or abrading aluminum parts that may come in contact with oxygen in the cryogenic liquid form may not be installed on any cargo tank used to transport oxygen, cryogenic liquid unless the parts are anodized in accordance with ASTM Standard B 580 (IBR, see §171.7 of this subchapter).

(5) An aluminum valve, pipe or fitting, external to the jacket that retains lading during transportation may not be installed on any cargo tank used